

The Integrated Detector Sample Cell

Figure 1

Dispersive Raman Spectra of Anthrax Simulants

Using a ChemIcon FALCON™ Raman Chemical Imaging Microscope

Brightfield Transmittance Image



- Bacteria deposited on microscope slide from aqueous suspension
- Microscope slide background spectrum subtracted from sample spectra

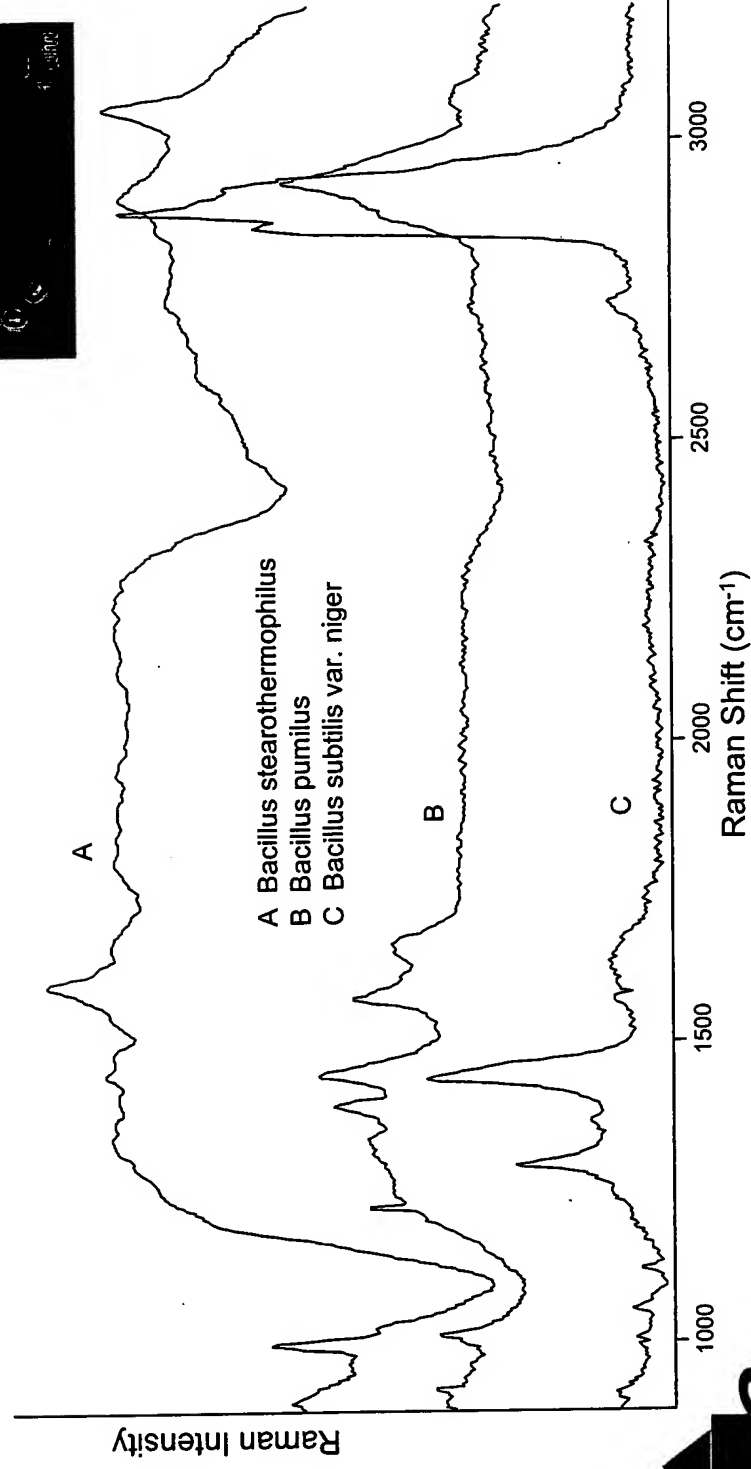


Figure 2

Fluorescence Chemical Imaging of *Bacillus Pumilus* and *Bacillus Subtilis* Mixture

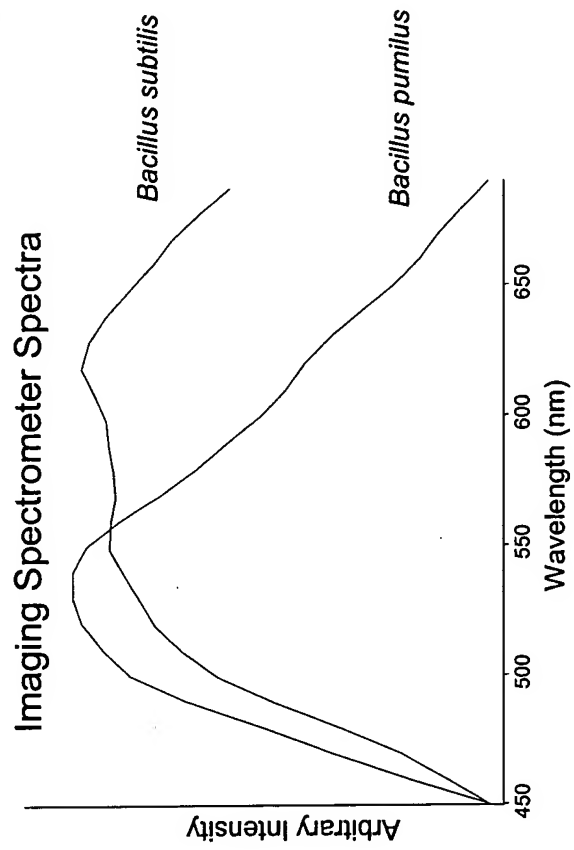
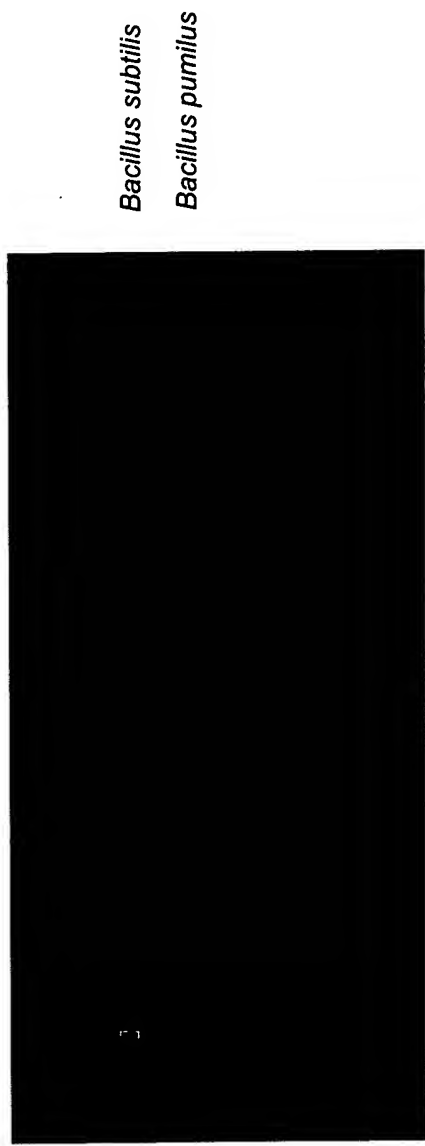


Figure 3

Dispersive Raman Spectroscopy of AFIP Powder Samples 532 nm Laser Excitation – Collected Through Vials (Raw Spectra)

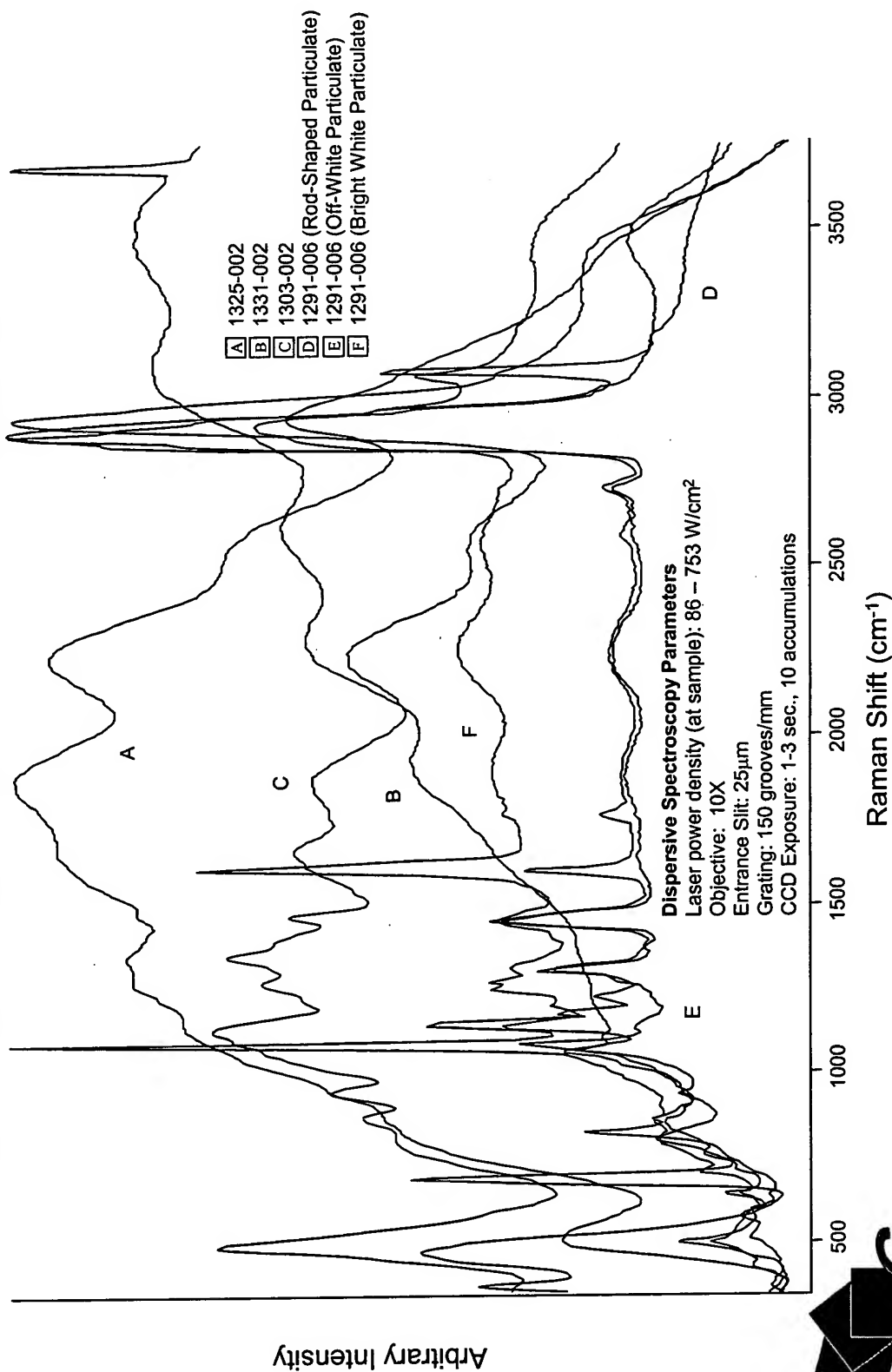


Figure 4A

Dispersive Raman Spectroscopy of AFIP Powder Samples 789.5 nm Laser Excitation – Collected Directly On Powders (Background Corrected)

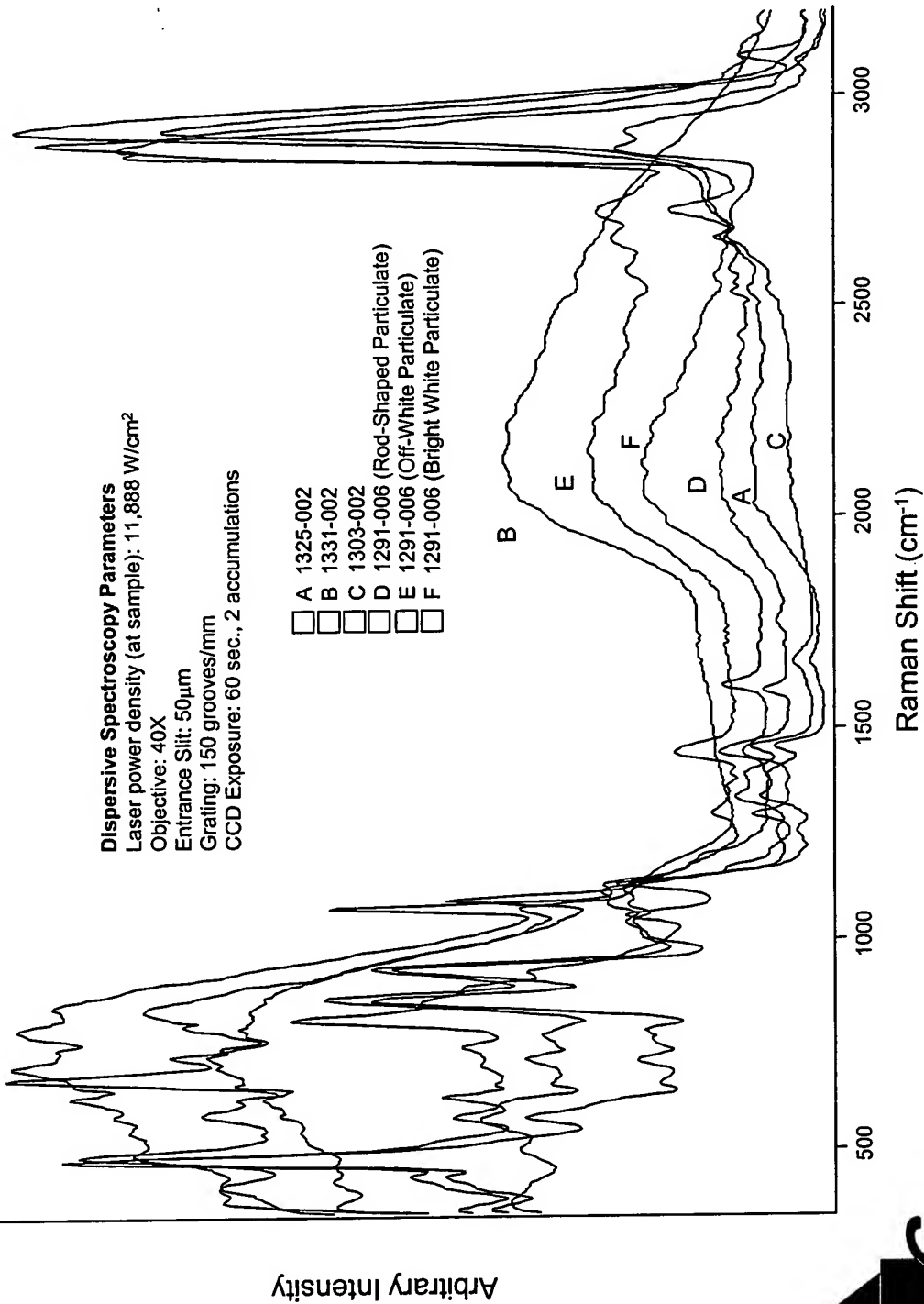


Figure 4B

Dispersive Raman and FT-IR Spectra of AFIP Powder Sample 1331-002

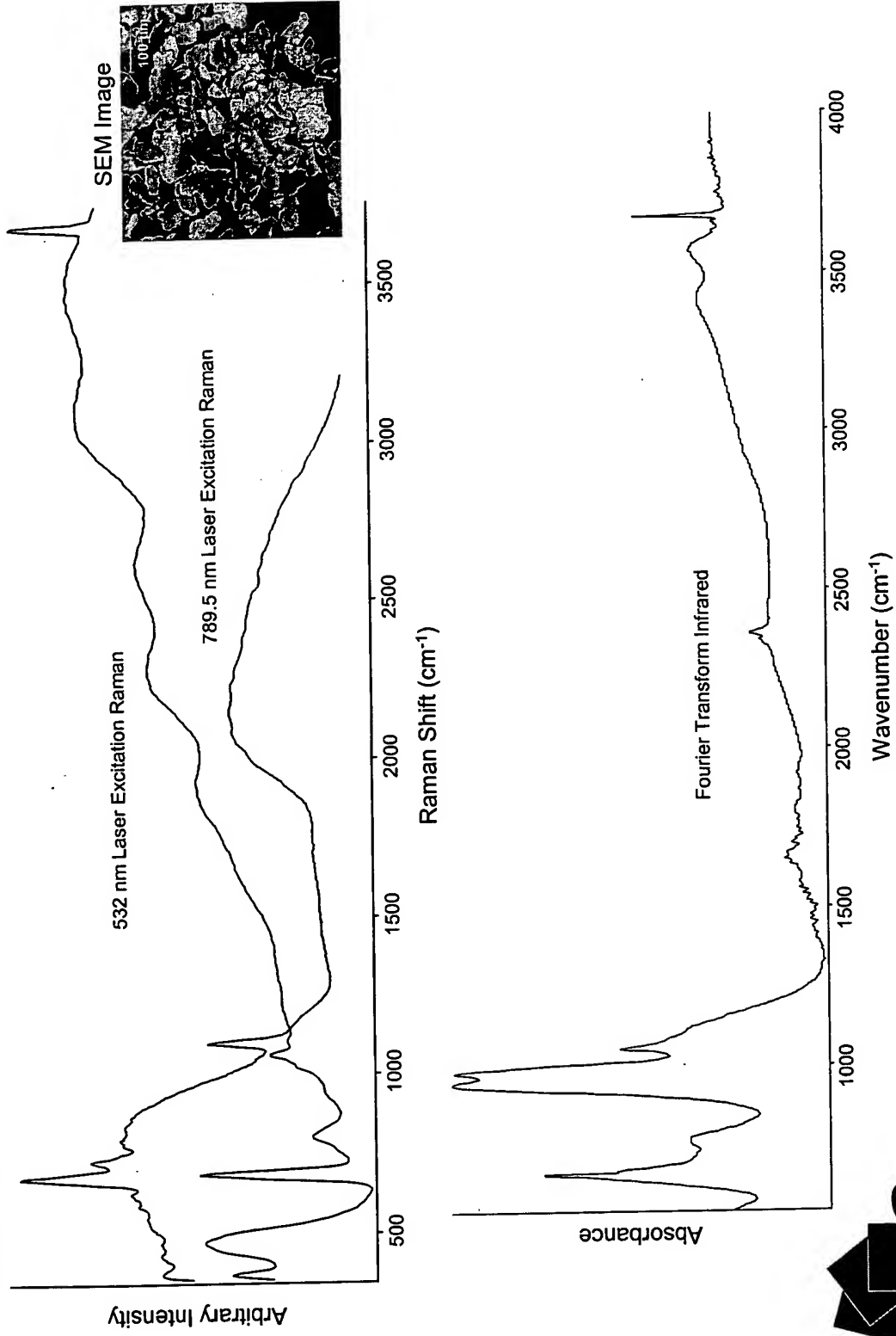


Figure 4C

SEM/EDS of AFIP Powder Sample 1331-002

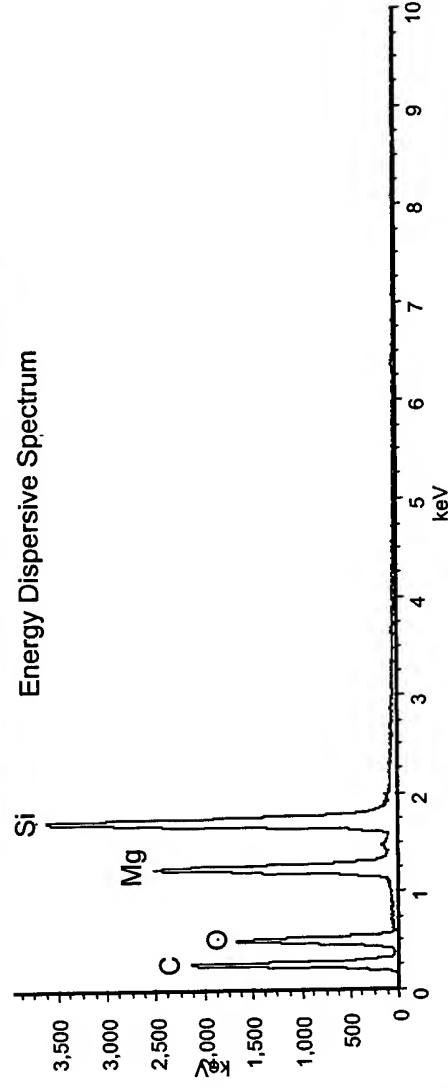


Figure 4D

Dispersive Raman and FT-IR Spectra of AFIP Powder Sample 1325-002

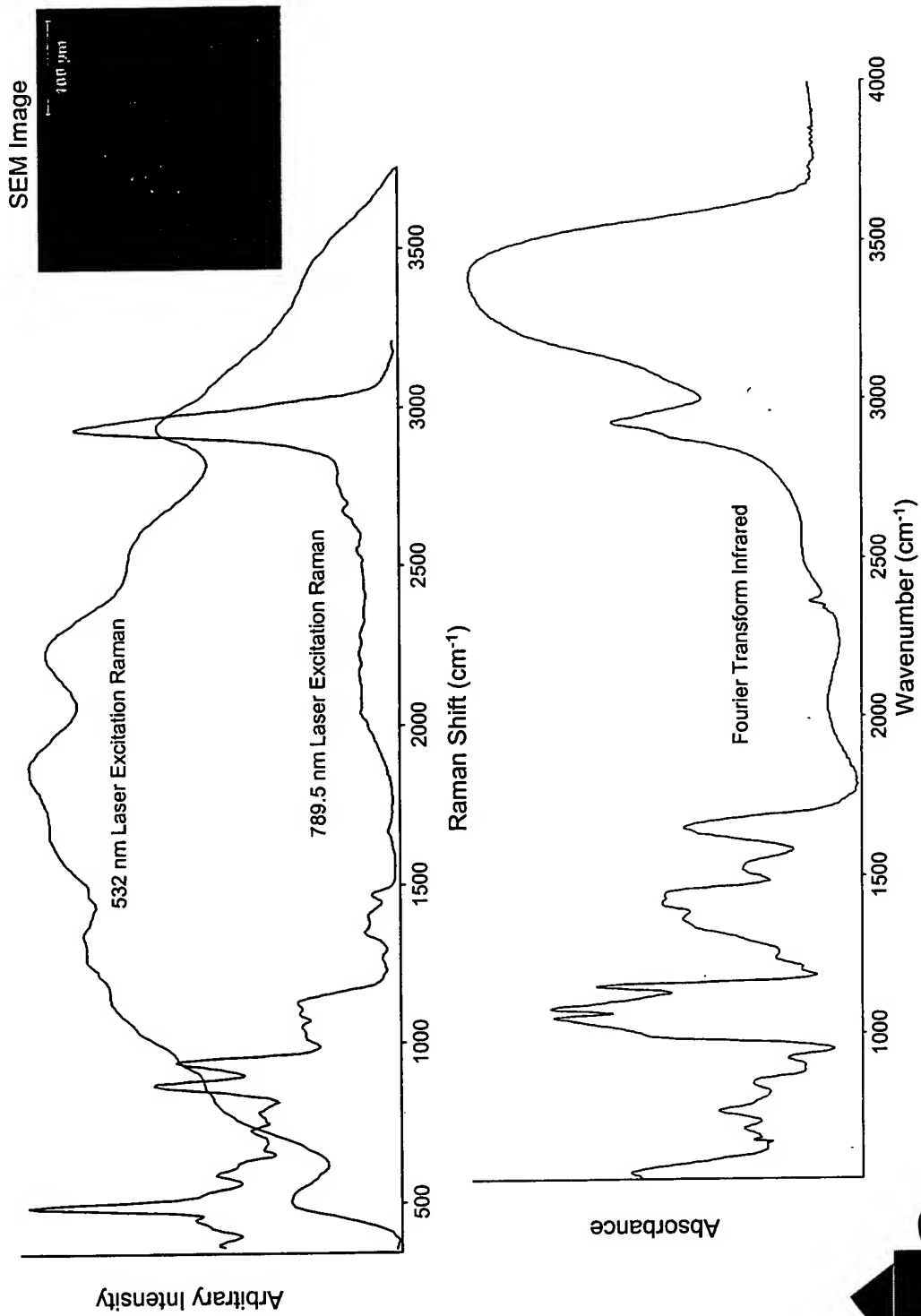


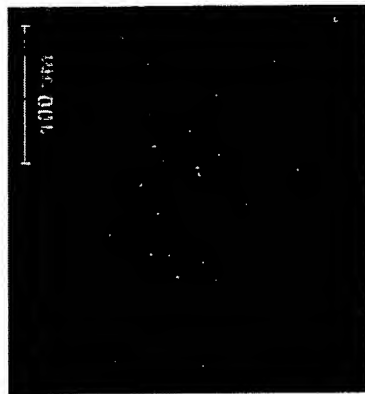
Figure 4E

SEM/EDS of AFIP Powder Sample 1325-002

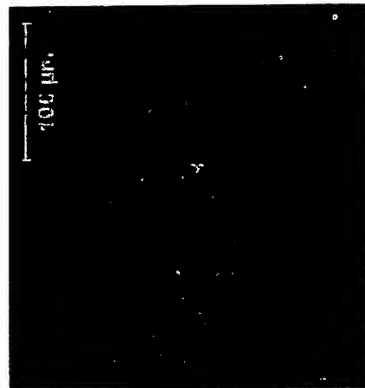
Polarized Light Image



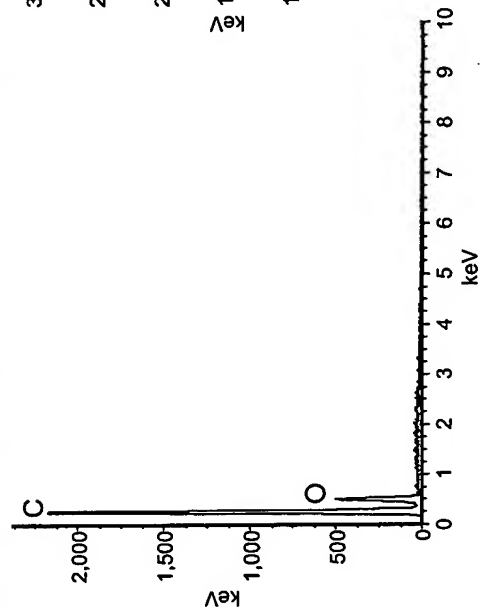
Backscattered Electron Image



Backscattered Electron Image



Energy Dispersive Spectrum



Energy Dispersive Spectrum

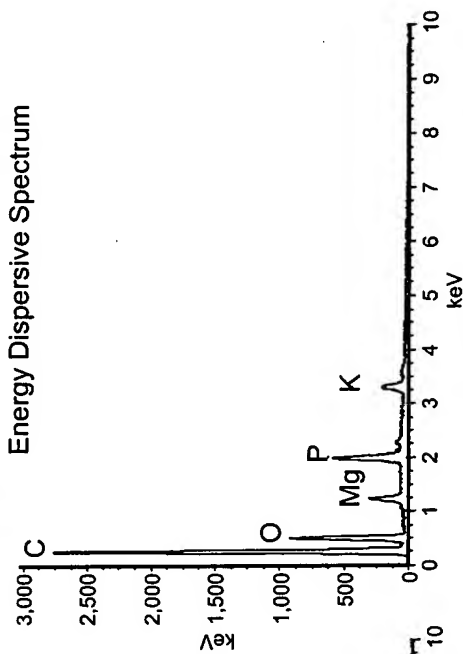


Figure 4F

Dispersive Raman and FT-IR Spectra of AFIP Powder Sample 1303-002

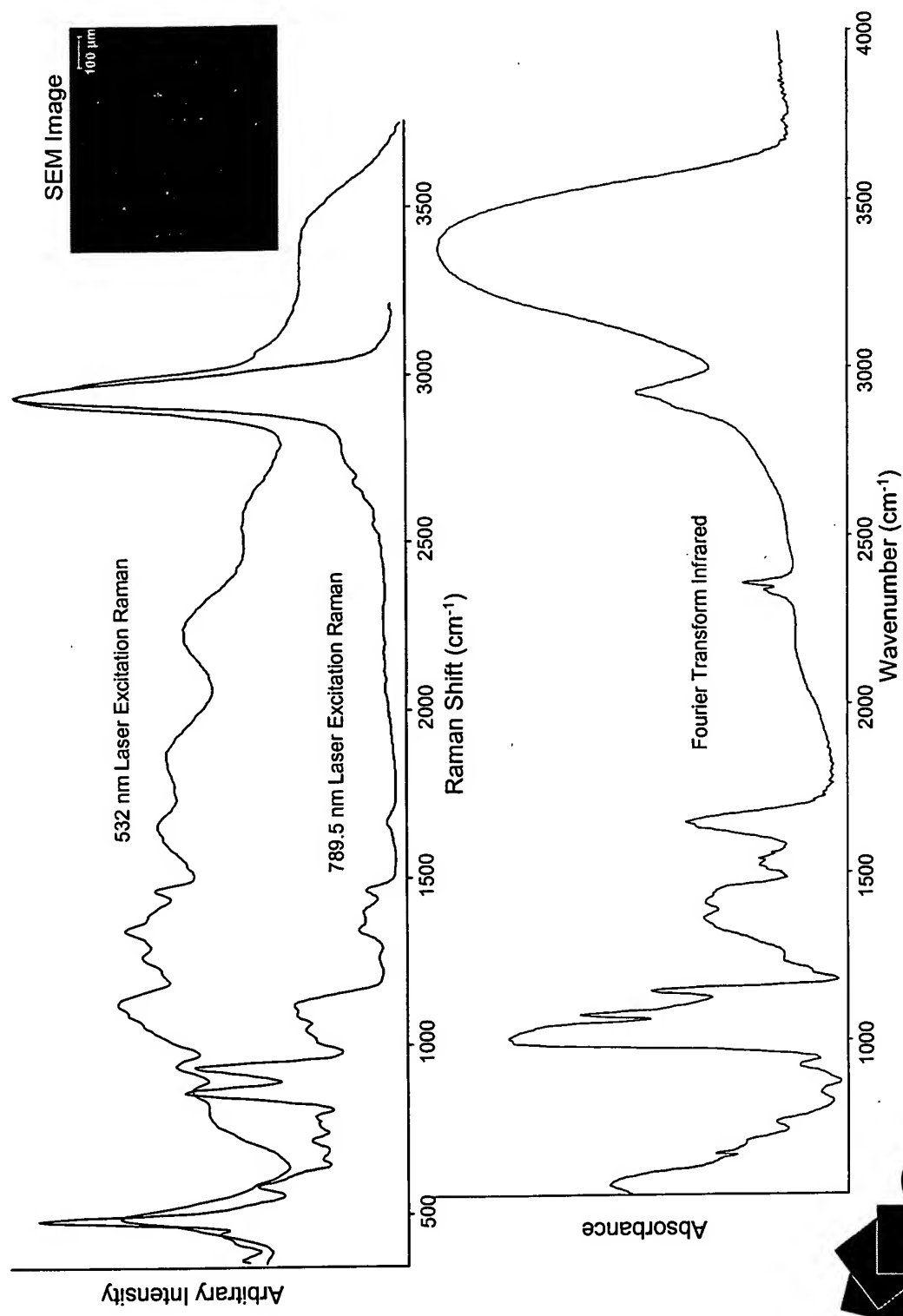


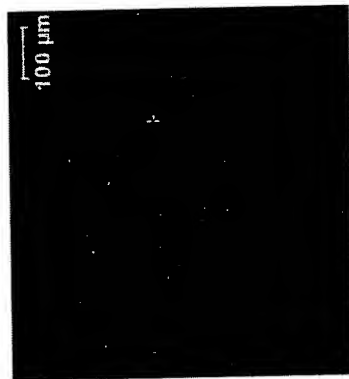
Figure 4G

SEM/EDS of AFIP Powder Sample 1303-002

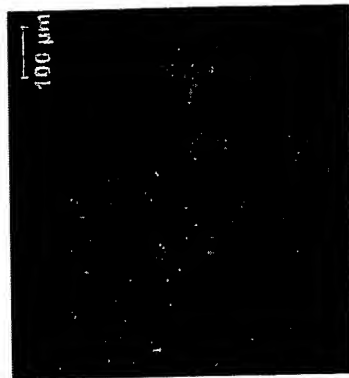
Polarized Light Image



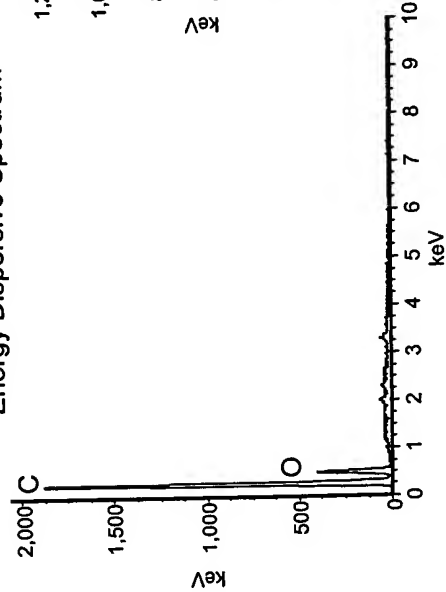
Backscattered Electron Image



Backscattered Electron Image



Energy Dispersive Spectrum



Energy Dispersive Spectrum

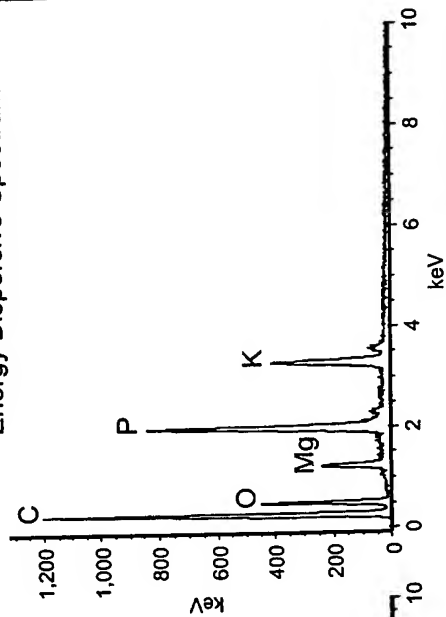


Figure 4H

Dispersive Raman and FT-IR Spectra of AFIP Powder Sample 1291-006 (Bright White Particulate)

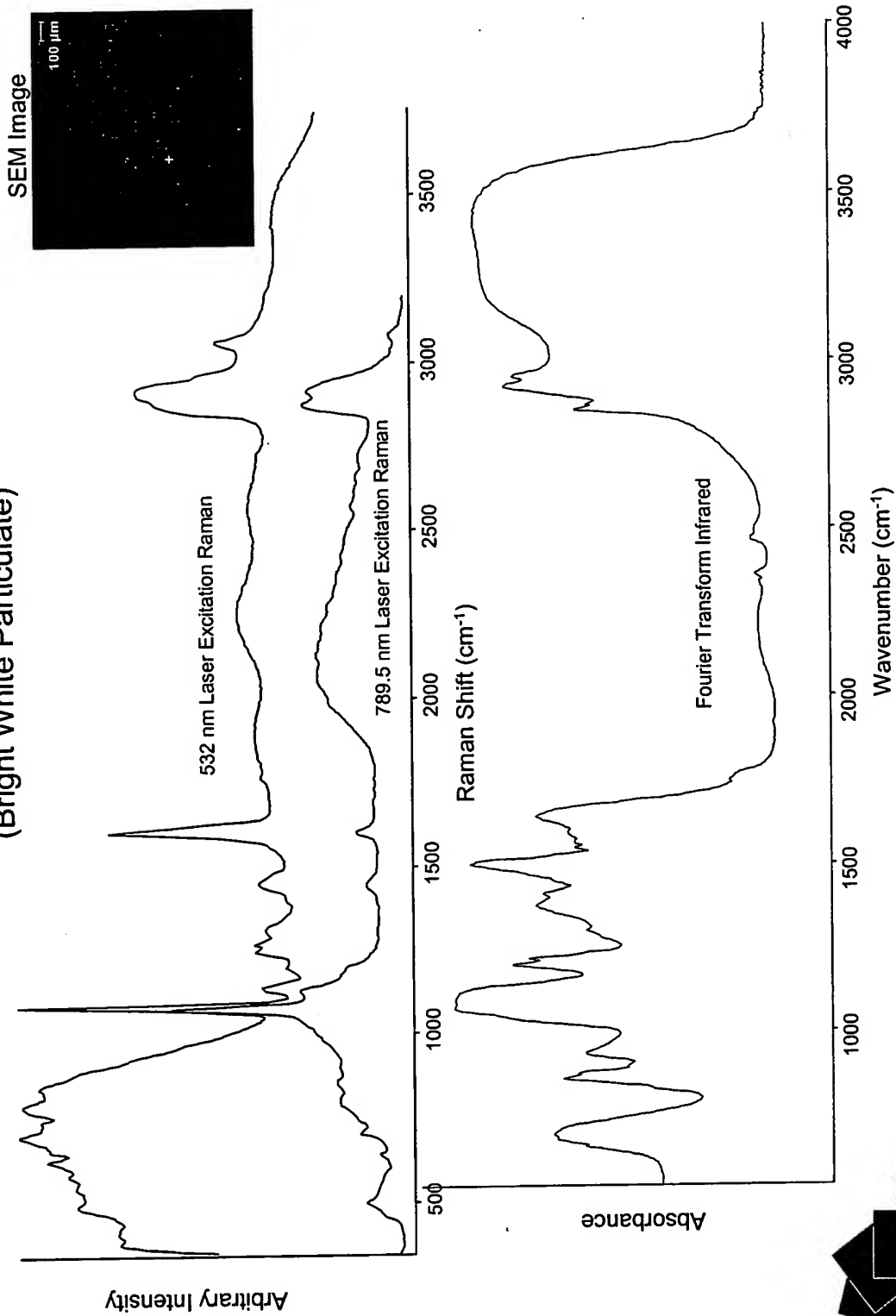
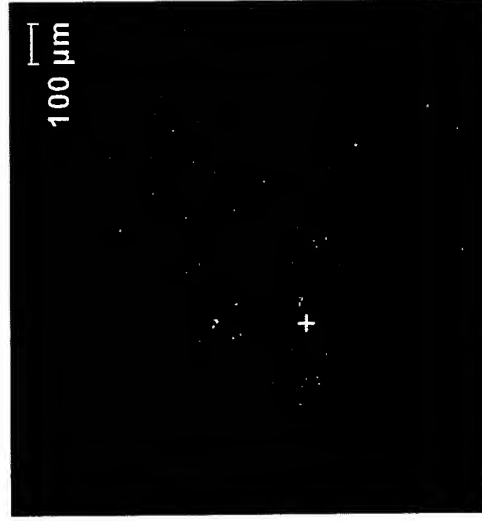


Figure 4I

SEM/EDS of AFIP Powder Sample 1291-006 (Bright White Particulate)

Backscattered Electron Image



Energy Dispersive Spectrum

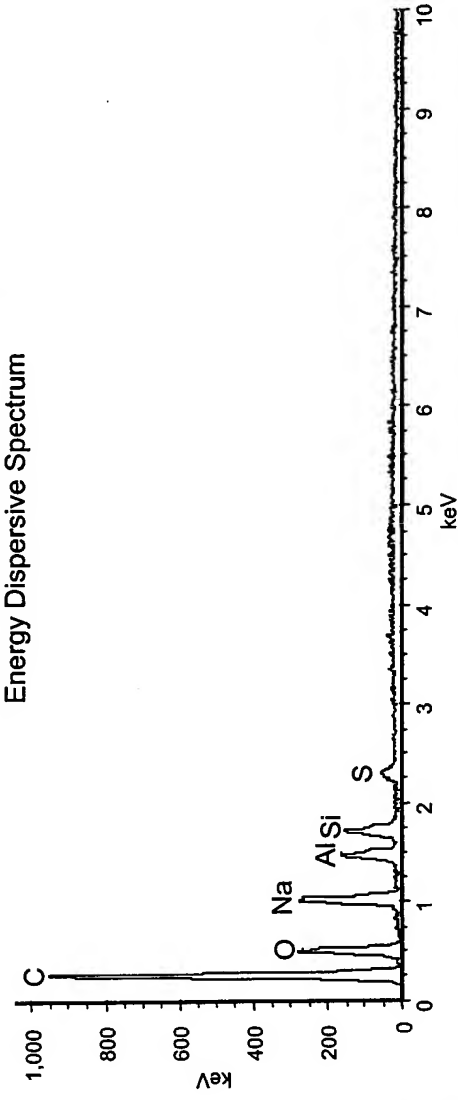


Figure 4J

Dispersive Raman and FT-IR Spectra of AFIP Powder Sample 1291-006 (Off-White Particulate)

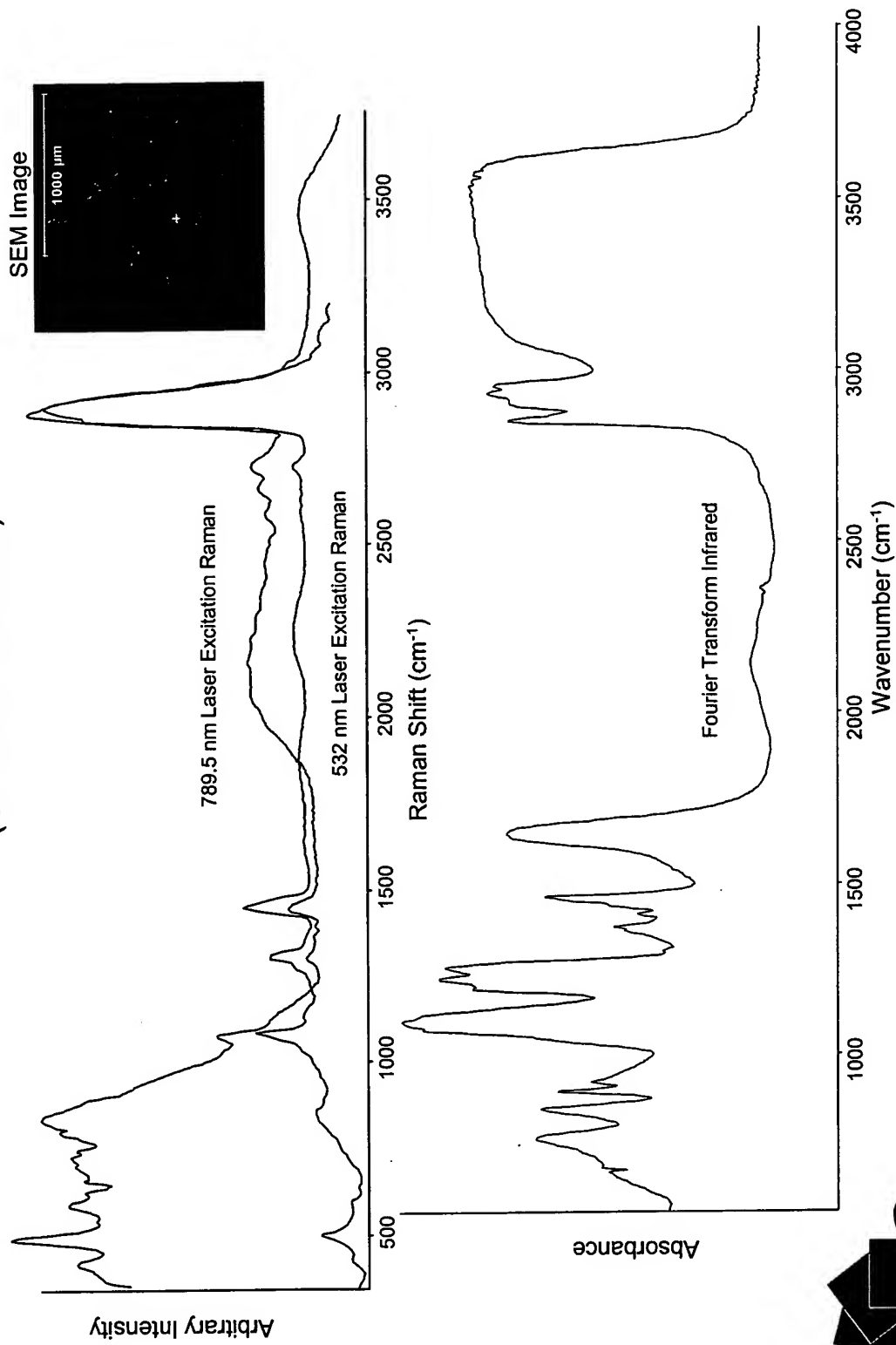
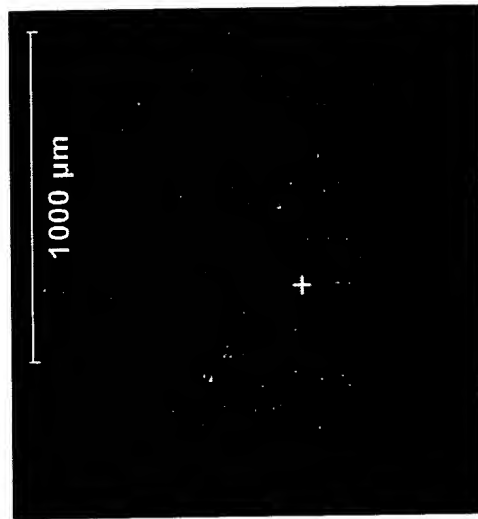


Figure 4K

SEM/EDS of AFIP Powder Sample 1291-006 (Off-White Particulate)

Backscattered Electron Image



Energy Dispersive Spectrum

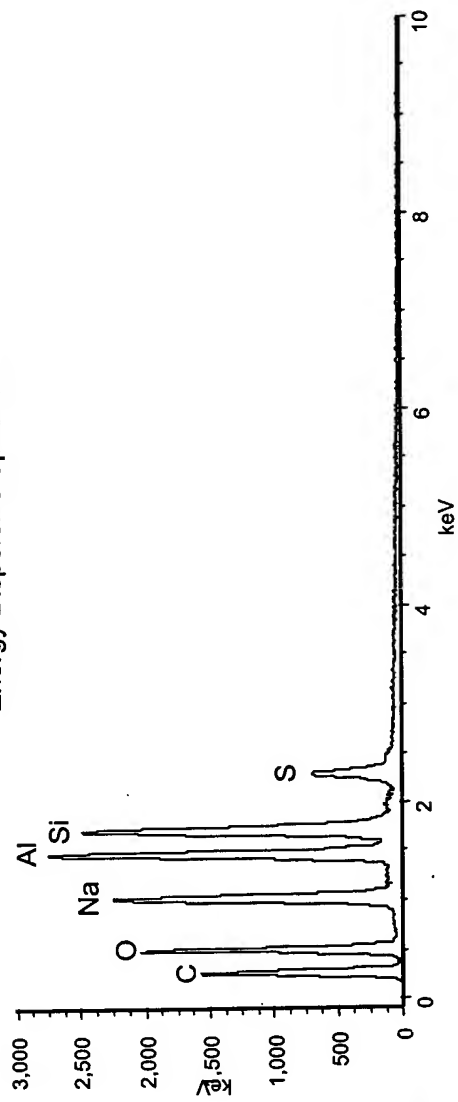


Figure 4L

Dispersive Raman and FT-IR Spectra of AFIP Powder Sample 1291-006
(Rod Shaped Particulate)

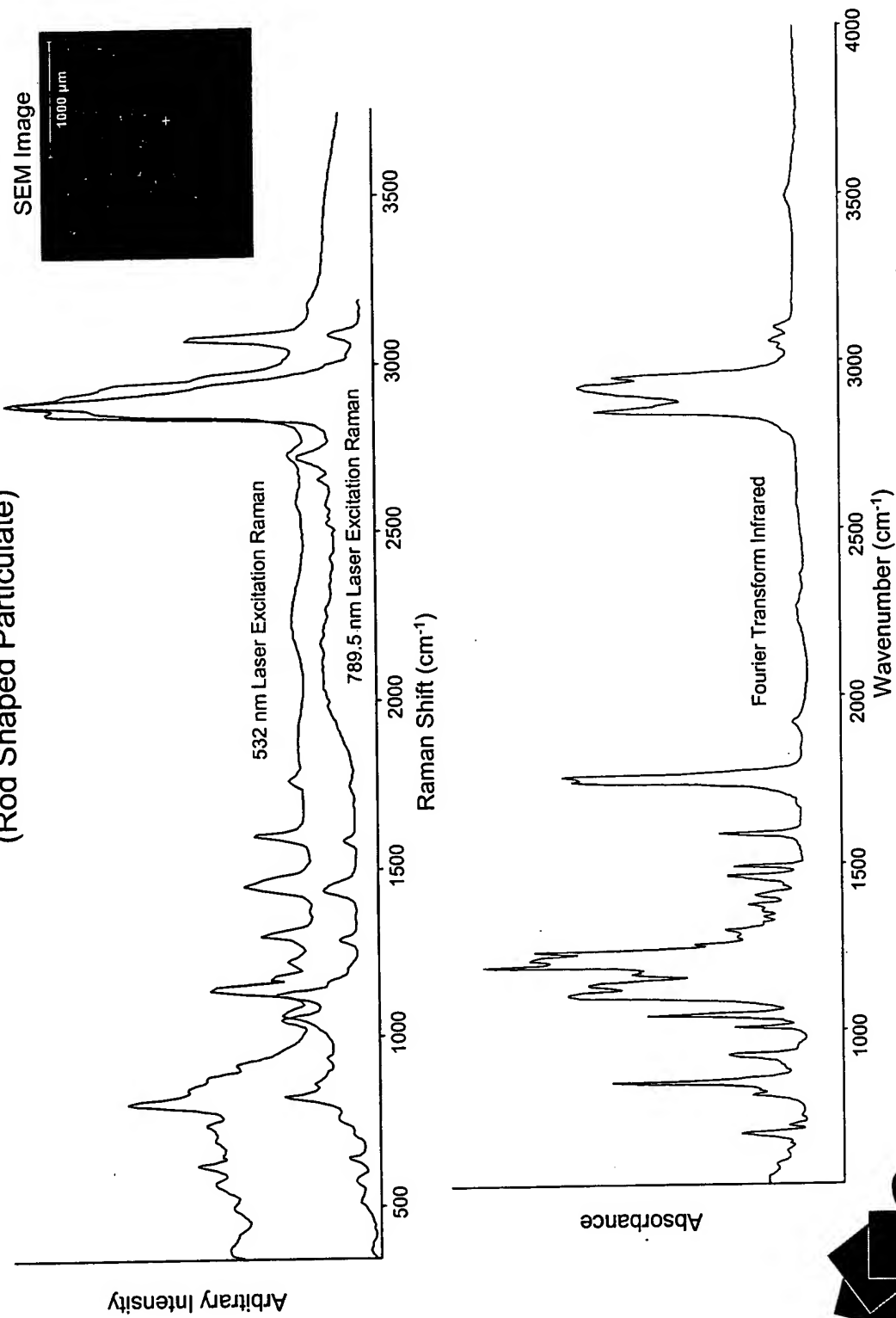


Figure 4M

SEM/EDS of AFIP Powder Sample 1291-006 (Rod-Shaped Particulate)

Backscattered Electron Image

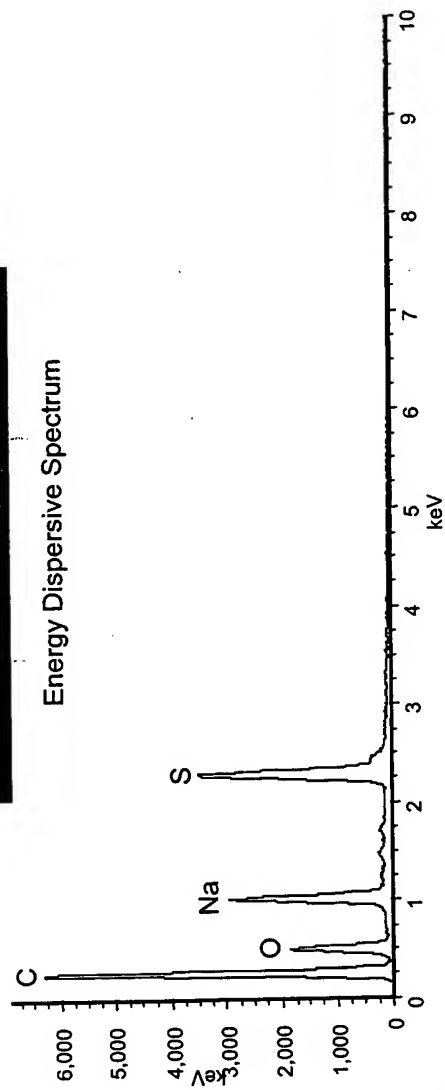
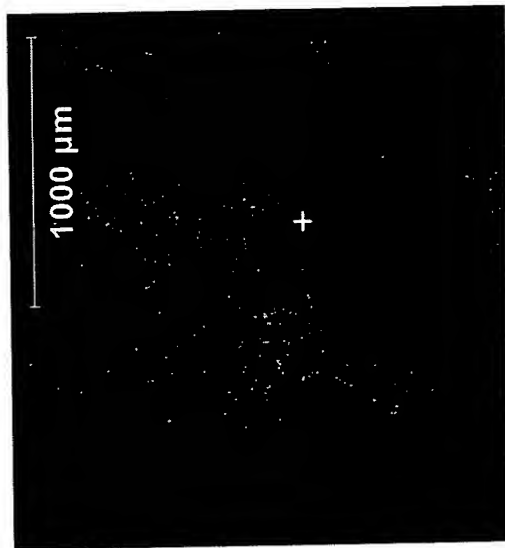


Figure 4N

Dispersive Raman Spectroscopy of Common White Powders

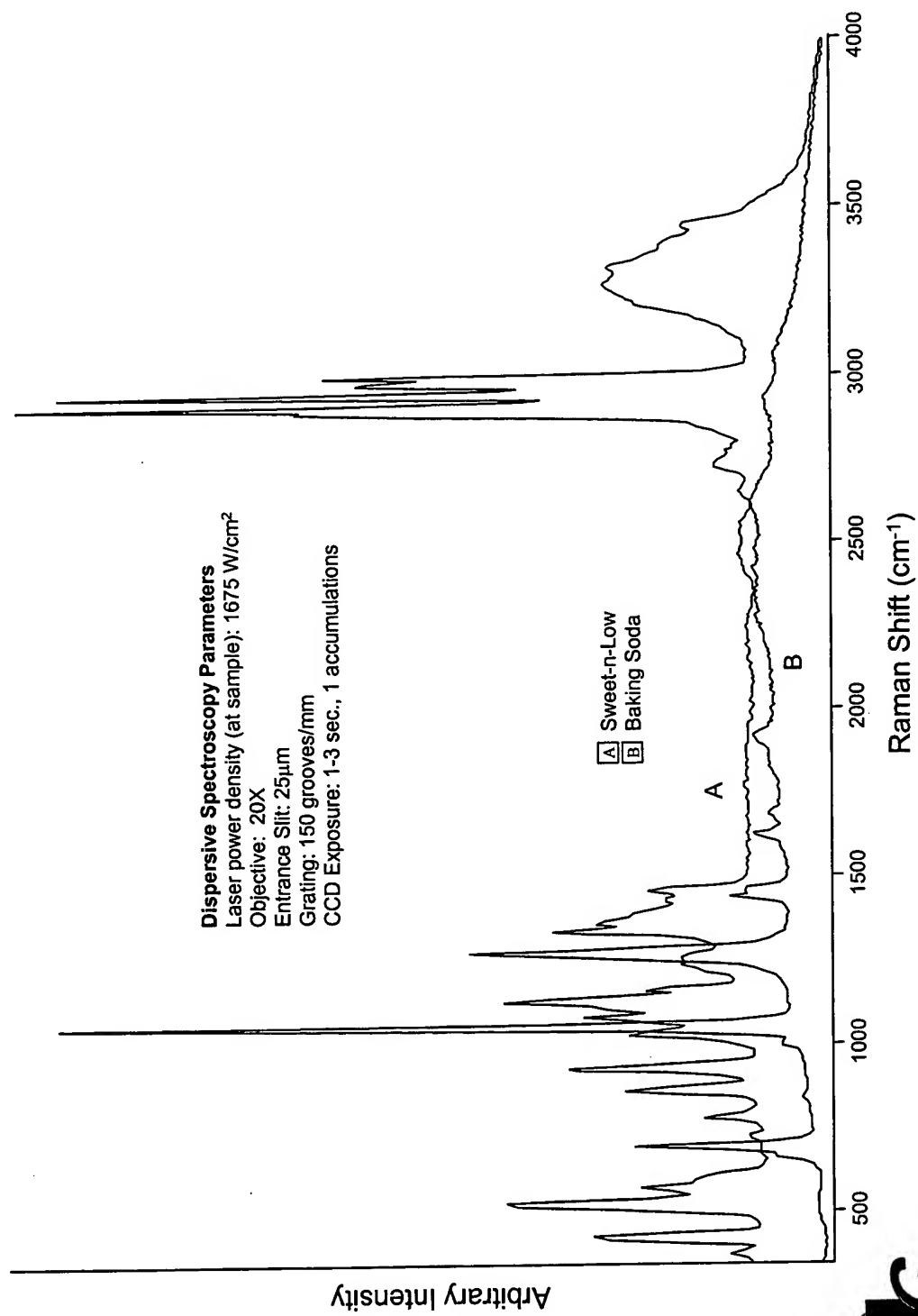


Figure 40

Dispersive Raman Spectroscopy of Bacillus Spores

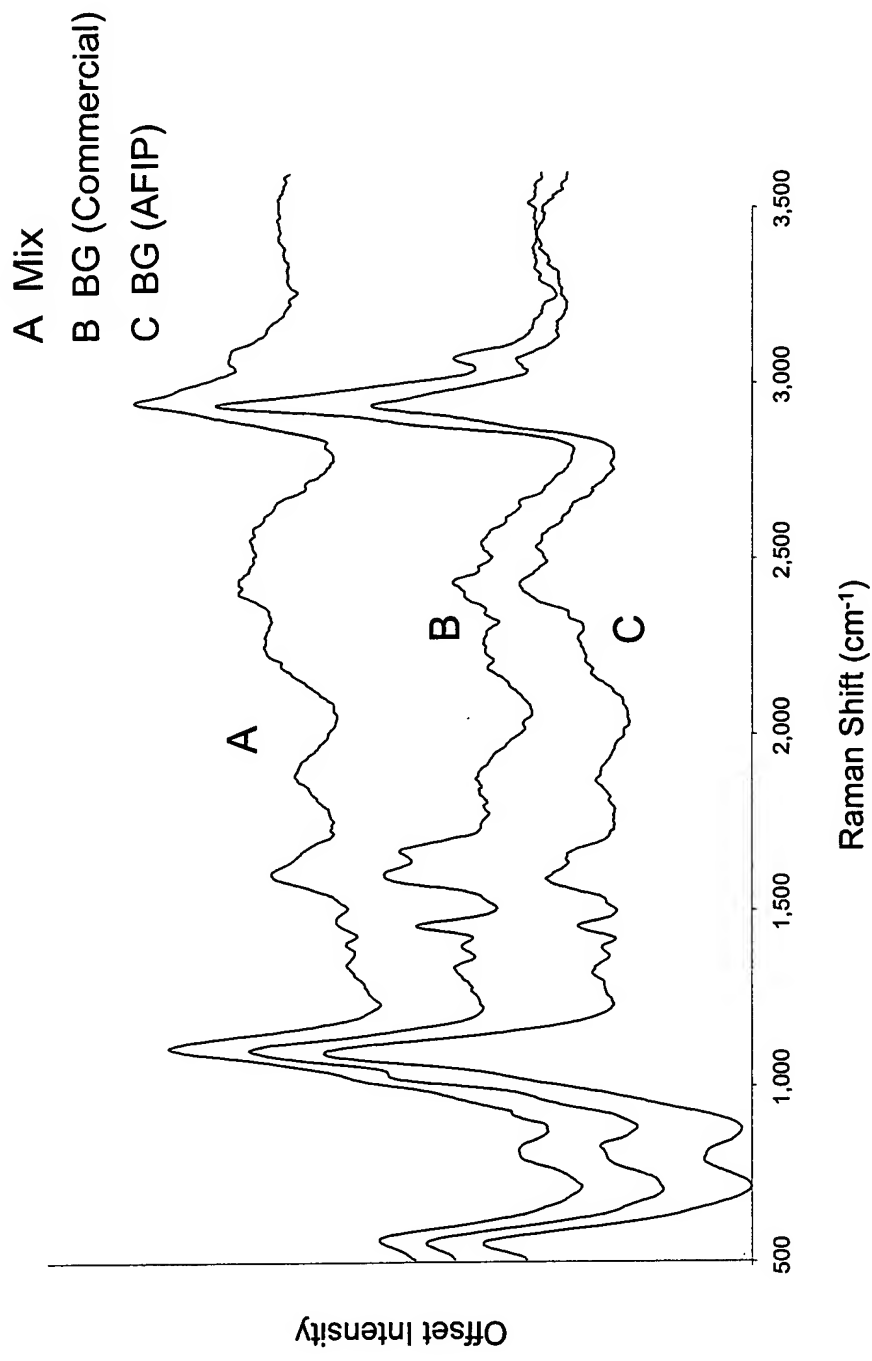
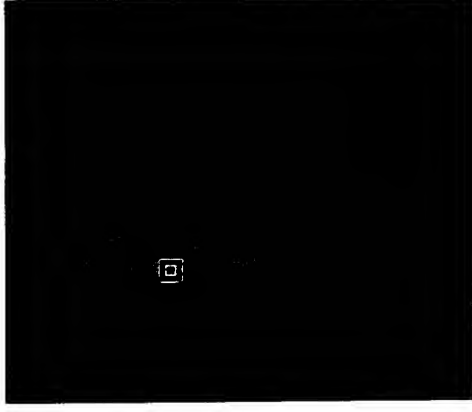
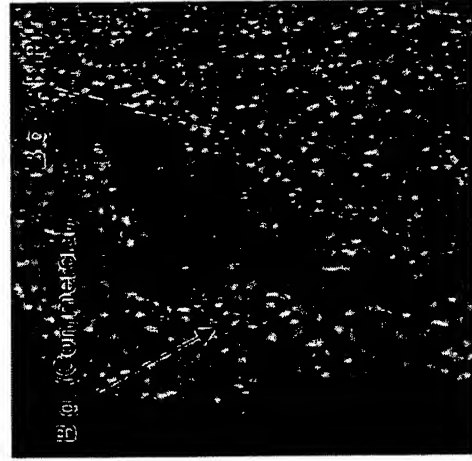


Figure 4P

Raman Chemical Imaging of Bacillus Subtilis Spore Mixture BG (AFIP) and BG (Commercial)



Imaging Spectrometer Spectra

A Bg (AFIP)
B Bg (Commercial)

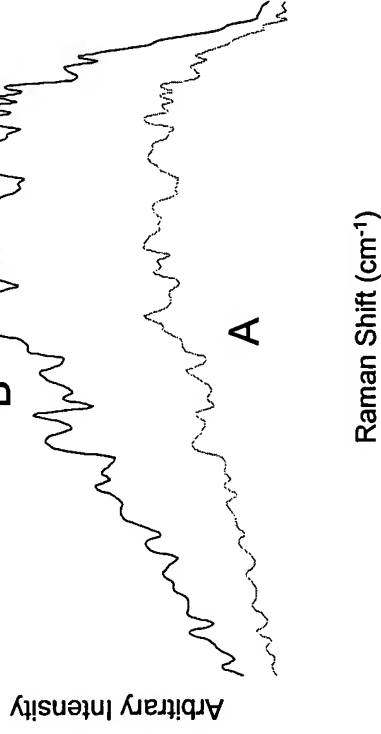


Figure 4Q

Dispersive Raman Spectra of *Bacillus thuringiensis* Sample

Raw Spectra

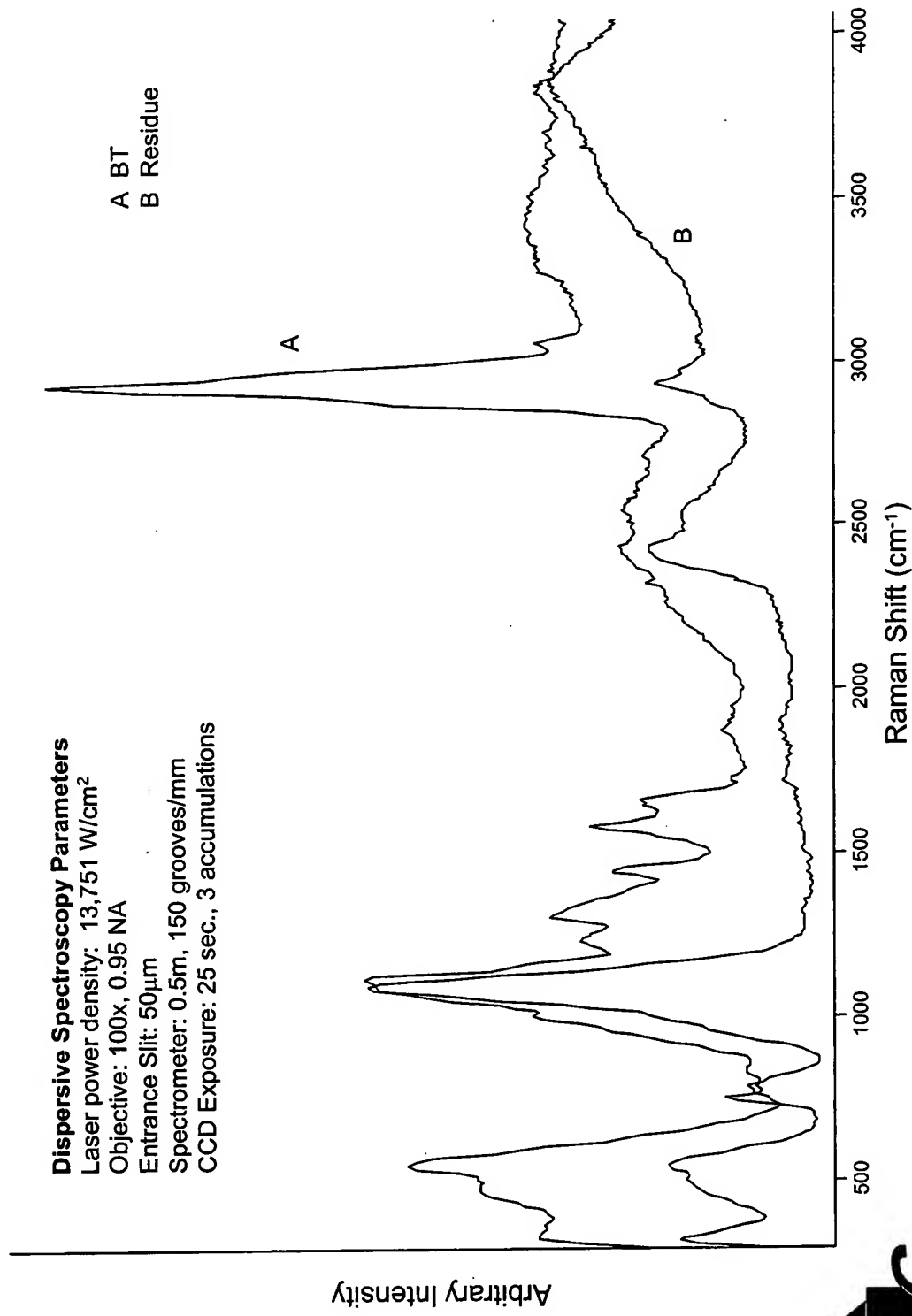


Figure 5A

Dispersive Raman Spectra of *Bacillus thuringiensis* Sampl

Divided Spectra

Dispersive Spectroscopy Parameters

Laser power density: 13,751 W/cm²

Objective: 100x, 0.95 NA

Entrance Slit: 50µm

Spectrometer: 0.5m, 150 grooves/mm

CCD Exposure: 25 sec., 3 accumulations

A BT
B Residue

Arbitrary Intensity



Raman Shift (cm⁻¹)

500 1000 1500 2000 2500 3000 3500 4000

Figure 5B

Dispersive Raman Spectra of *Bacillus cereus* Sample

Raw Spectra

Dispersive Spectroscopy Parameters

Laser power density: 13,751 W/cm²

Objective: 100x, 0.95 NA

Entrance Slit: 50µm

Spectrometer: 0.5m, 150 grooves/mm

CCD Exposure: 25 sec., 3 accumulations

A BC
B Residue

Arbitrary Intensity

Raman Shift (cm⁻¹)



Figure 5C

Dispersive Raman Spectra of *Bacillus cereus* Sample

Divided Spectra

Dispersive Spectroscopy Parameters

Laser power density: 13,751 W/cm²
Objective: 100x, 0.95 NA
Entrance Slit: 50µm
Spectrometer: 0.5m, 150 grooves/mm
CCD Exposure: 25 sec., 3 accumulations

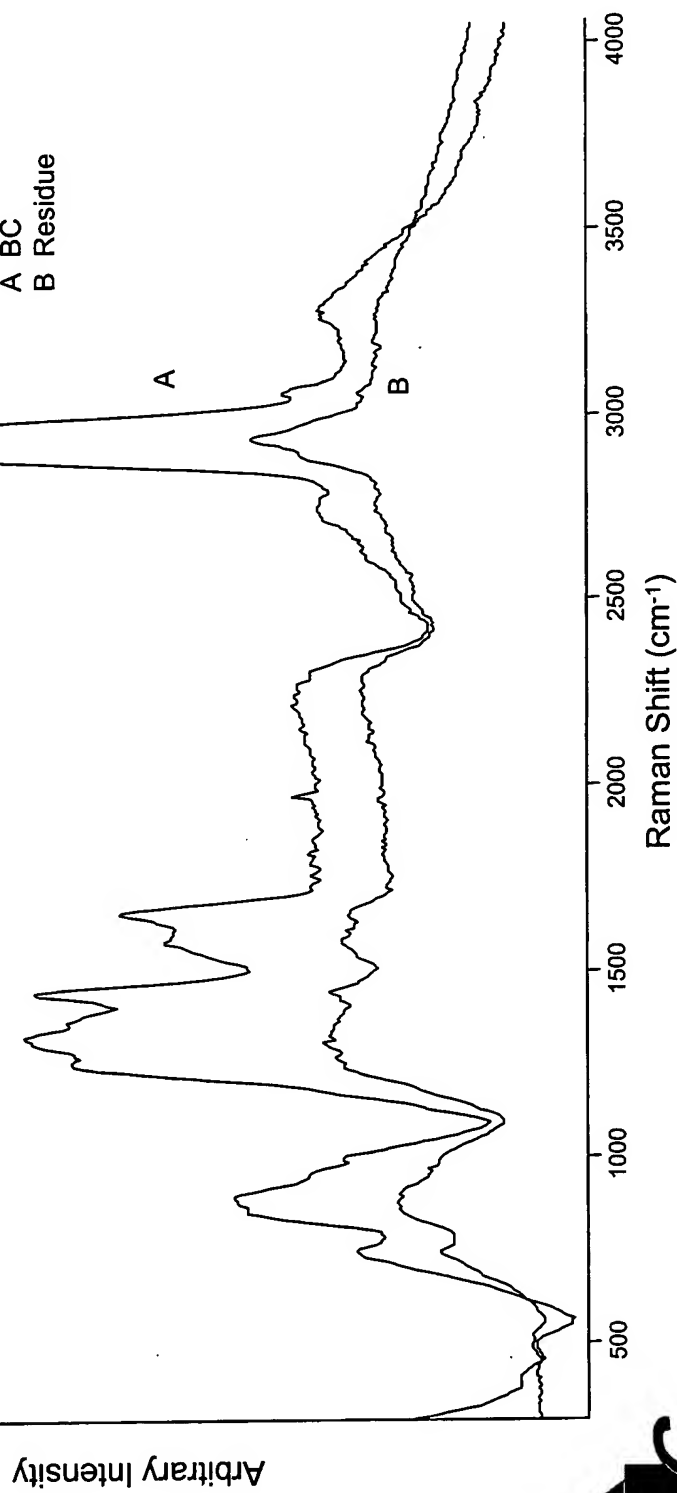


Figure 5D

Dispersive Raman Spectra of AFIP Samples Divided Spectra

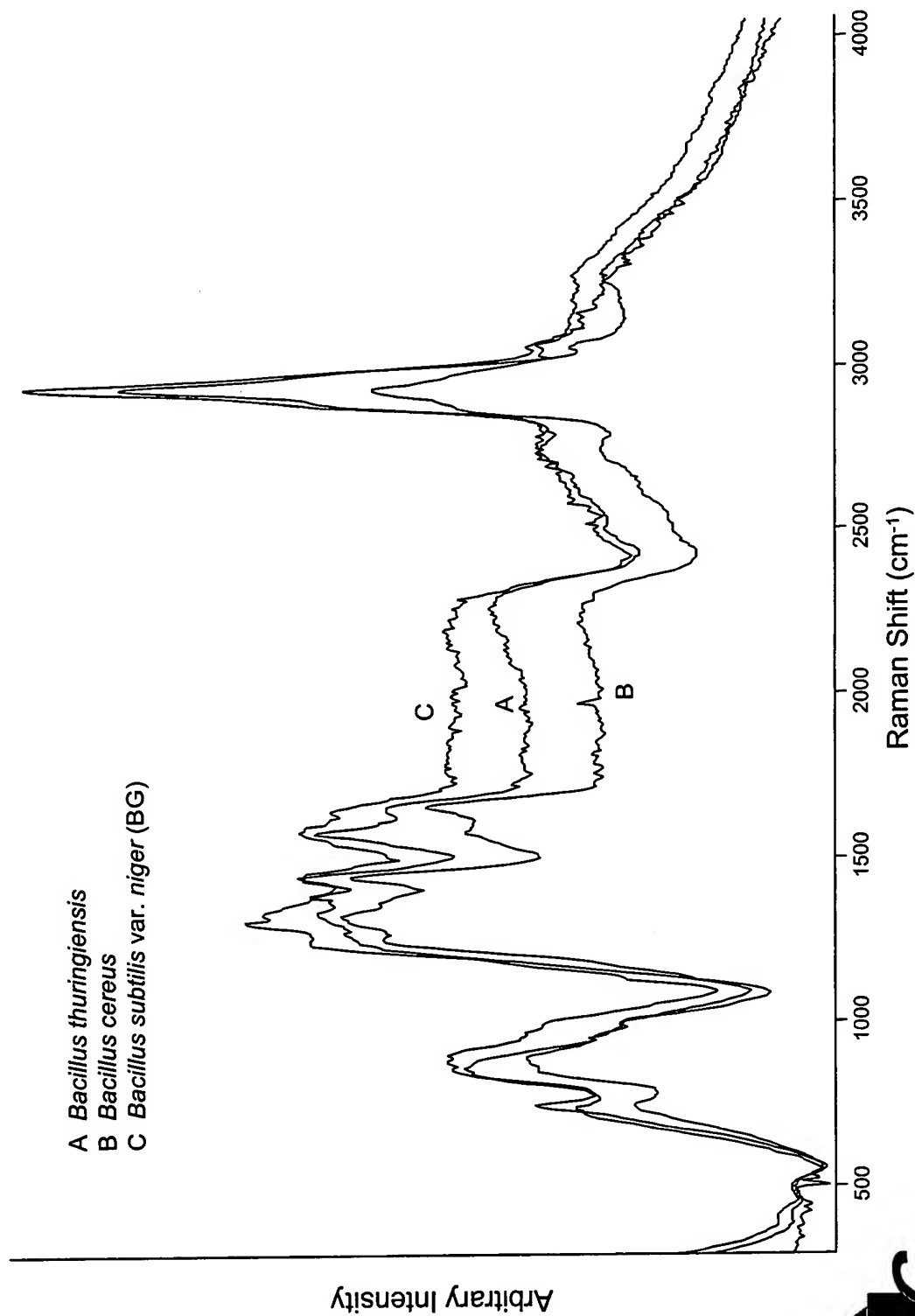


Figure 5E

Dispersive Raman Spectra of AFIP Samples

Baseline-Corrected

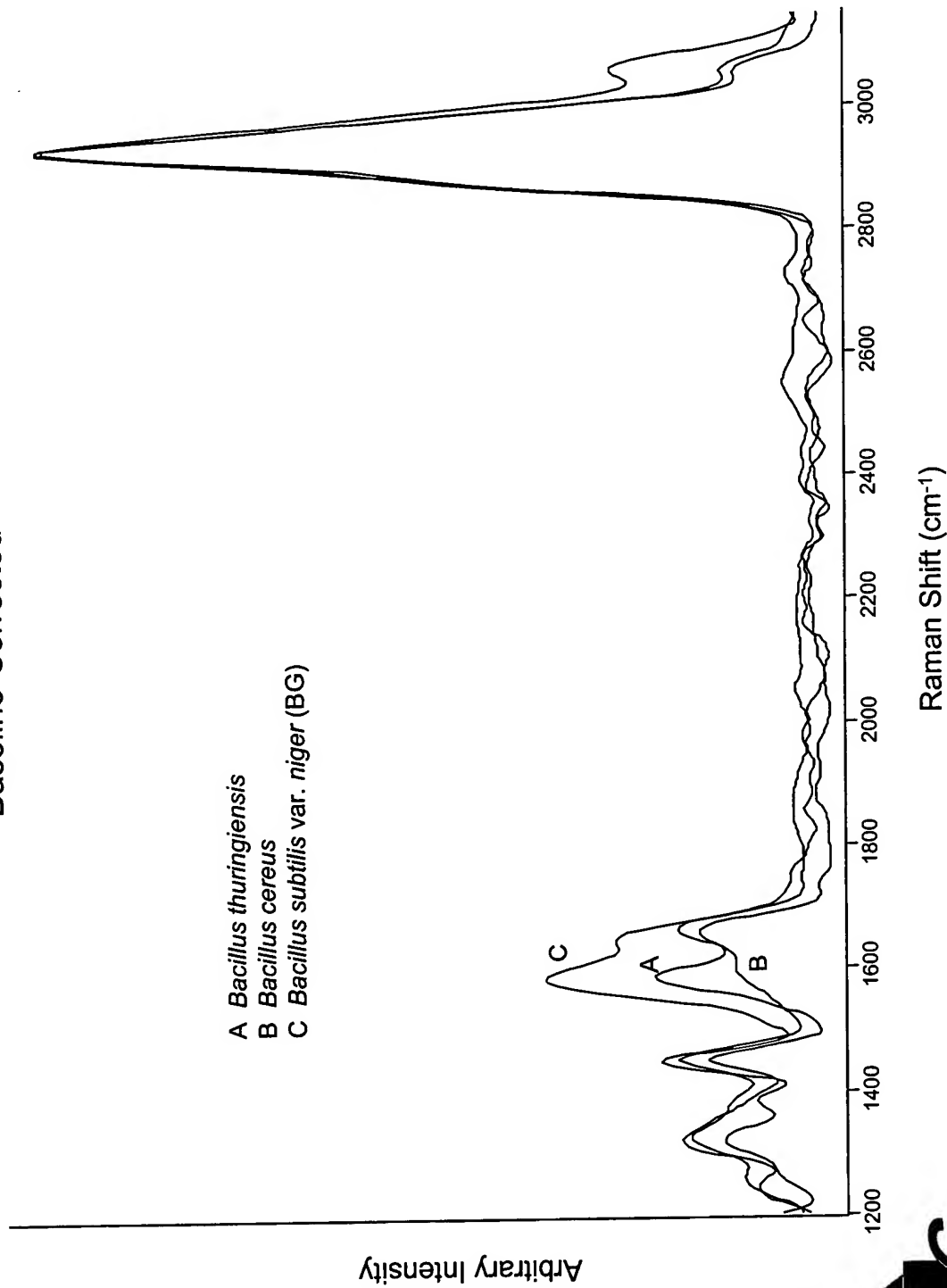
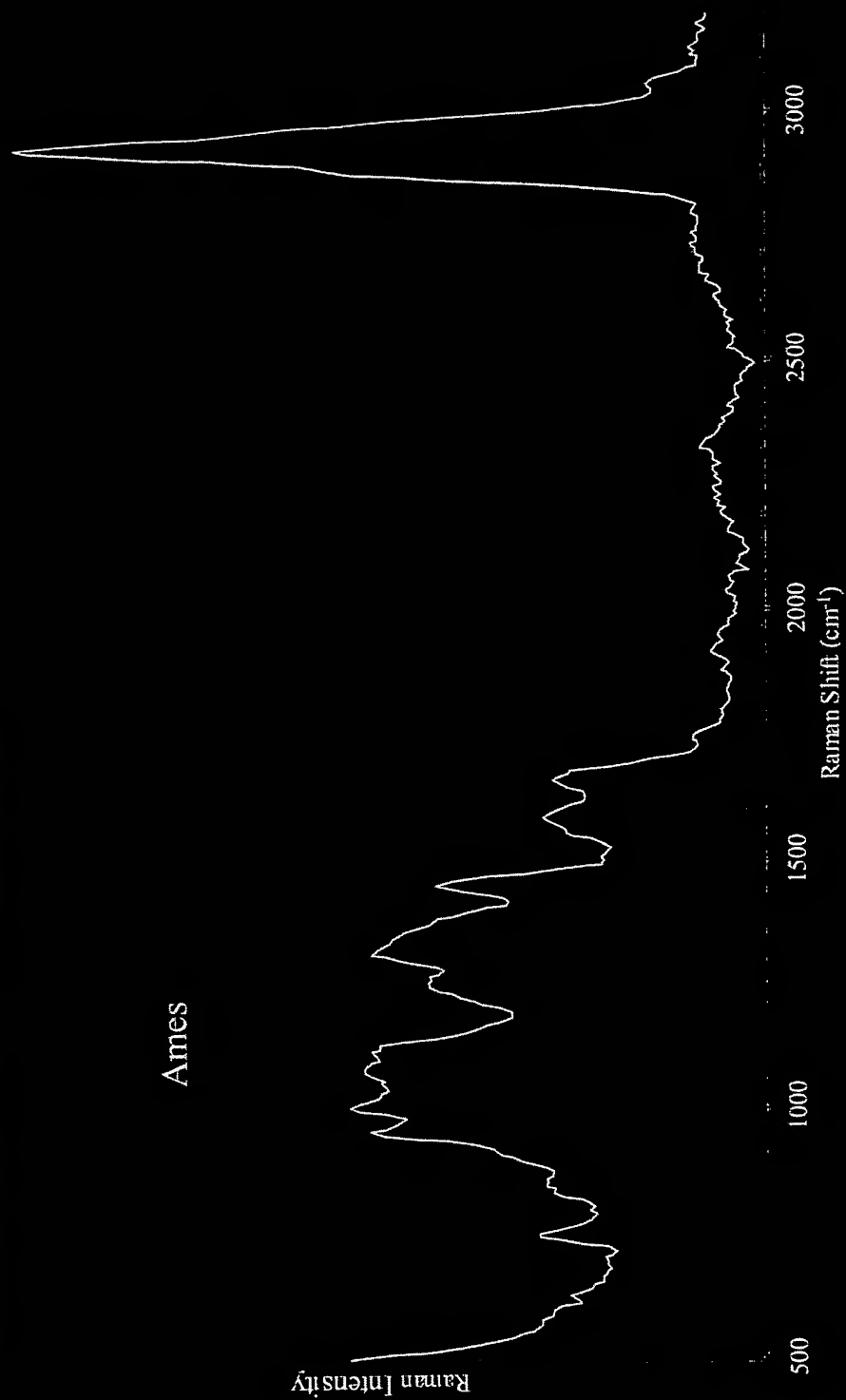


Figure 5F

Bacillus anthracis – Different Strains

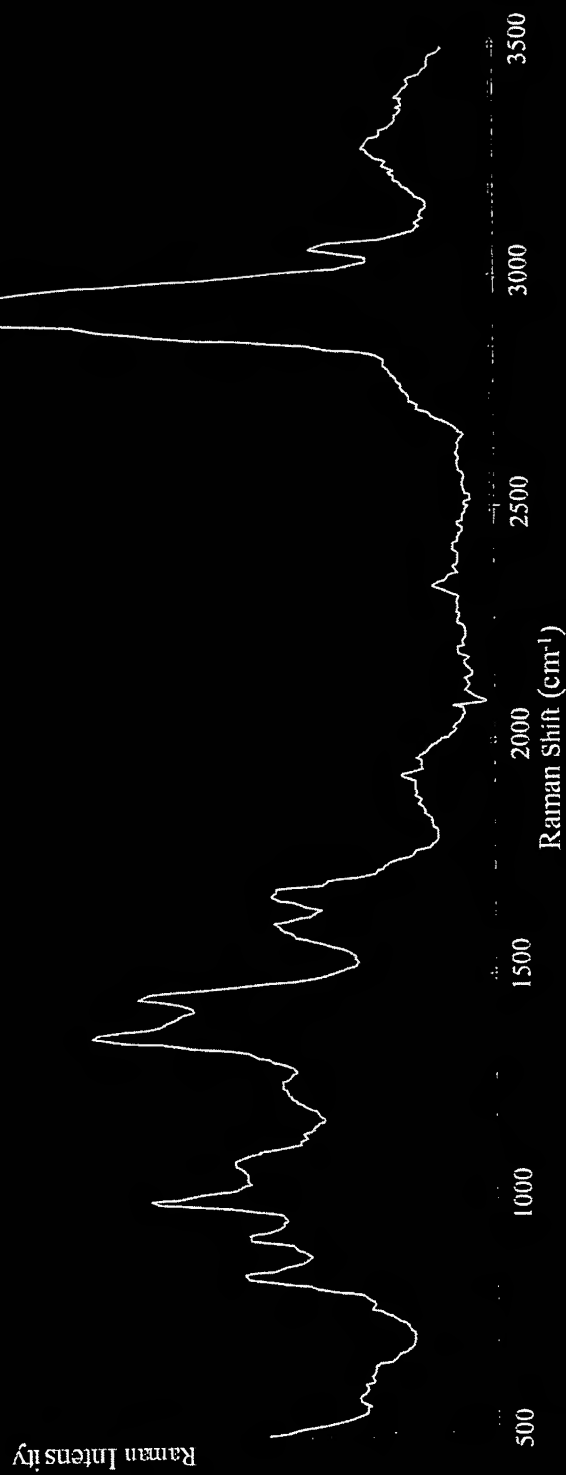


RCl can distinguish between multiple bacterial strains within a single species.

FIGURE 6

Bacillus anthracis – Different Growth Media

Sporulation Broth



RCI can distinguish between different growth conditions.

FIGURE 7

Raman Spectra are reproducible

AFIP Samples – *B. Anthracis* in Sporulation Broth Dispersive Raman Spectroscopy – 10 Different Regions of Interest

- Statistical Analysis (F-Test) indicates reproducibility to 95% confidence level
- Collected with FALCON Raman Chemical Imaging Microscope
- Data Acquisition Time: 60 sec/spectrum

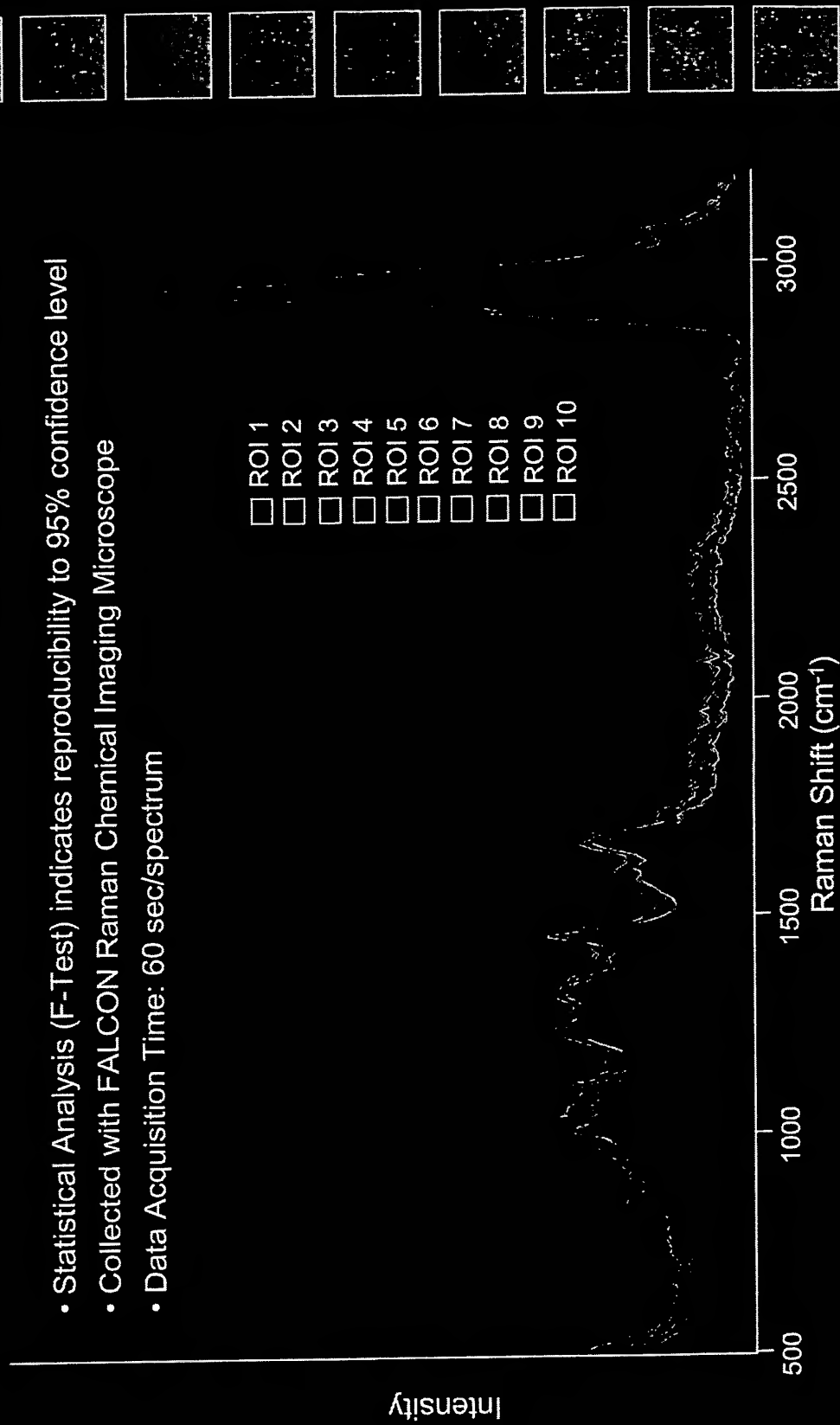
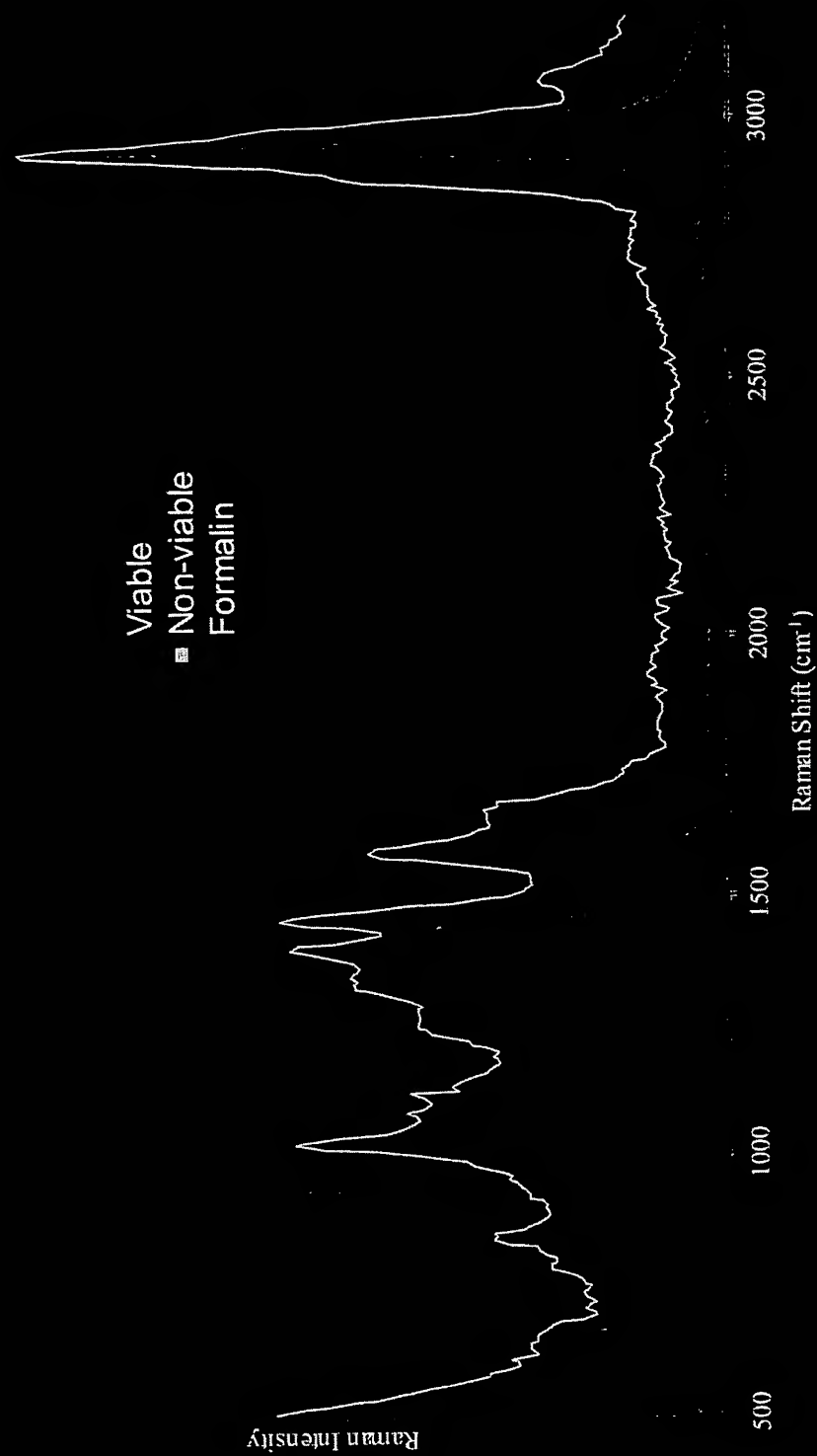


FIGURE 8

Bacillus cereus – Viable vs. Non-viable spores



RCI can distinguish between viable and non-viable spores

FIGURE 9

1. The first two plots show the
 distribution of spores in the
 sample.

2. The third plot shows the
 distribution of spores in the
 sample.

3. The fourth plot shows the
 distribution of spores in the
 sample.

4. The fifth plot shows the
 distribution of spores in the
 sample.

5. The sixth plot shows the
 distribution of spores in the
 sample.

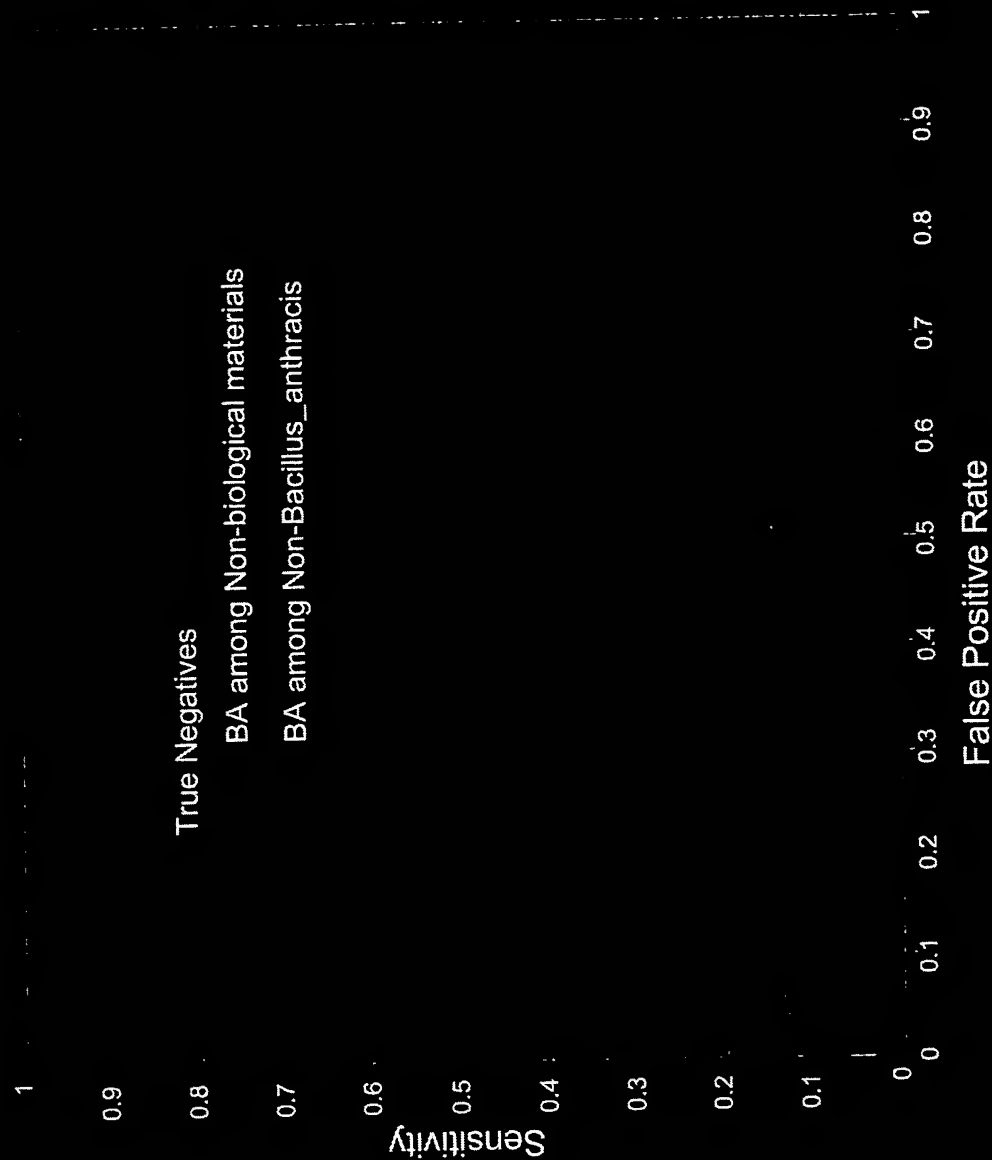
6. The seventh plot shows the
 distribution of spores in the
 sample.

7. The eighth plot shows the
 distribution of spores in the
 sample.

8. The ninth plot shows the
 distribution of spores in the
 sample.

FIGURE 10

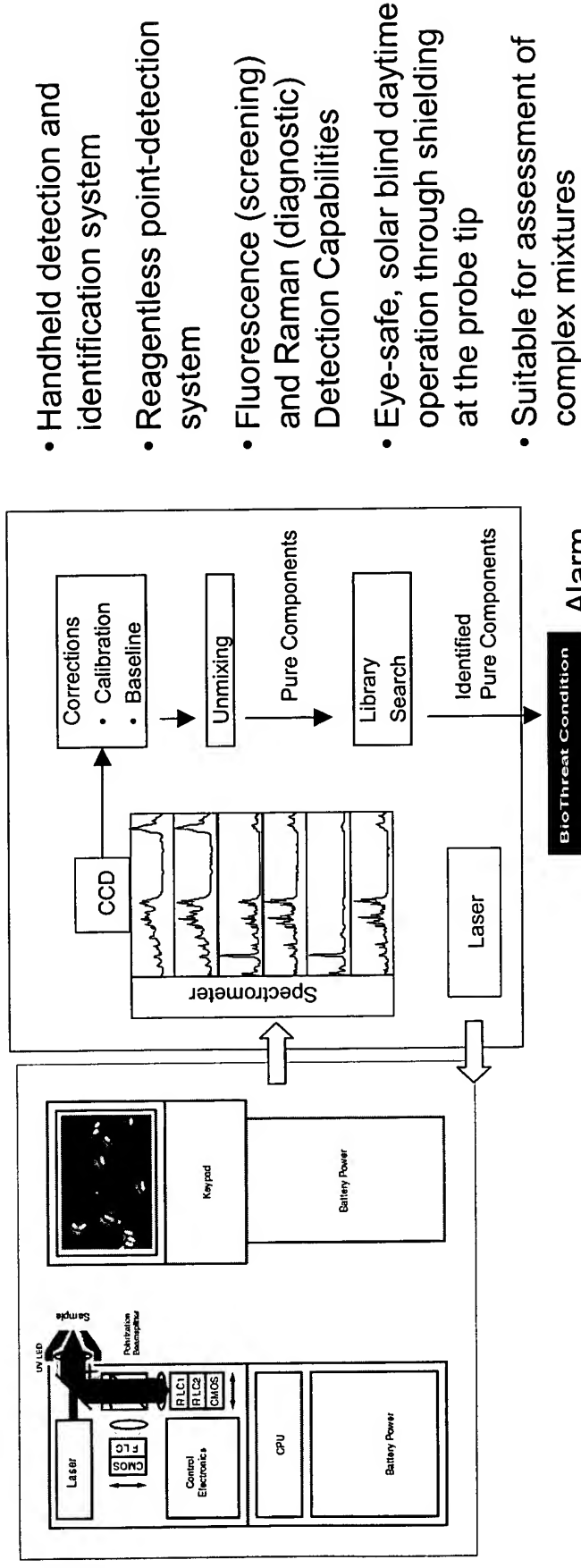
Preliminary Receiver Operator Characteristic (ROC) Curve *Bacillus anthracis* Discrimination Assessment



- Using un-optimized discrimination approach, at 90% probability of detection, 5X improvement in false alarm rate demonstrated

FIGURE 11

Handheld Pathogenic Microorganism Detector



Simple User Interface

Alarm

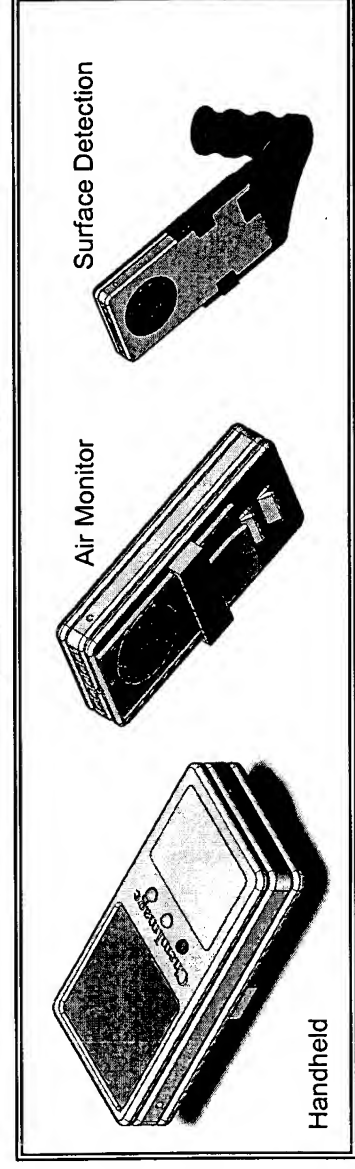


FIGURE 12

